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# TURFGRASS SCIENCE

at the University of Tennessee

## Safety of Herbicides Compared to Other Commonly Used Chemicals

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### Introduction

Herbicides are products that are used to control weeds. Concern over herbicide safety has led to increases in some natural weed control methods, such as salt and vinegar applications. In some parts of the United States and Canada, the use of herbicides to control turfgrass weeds has been banned entirely. However, materials used for natural weed control, such as salt and vinegar, also have toxicological properties similar to herbicides. This publication was developed to provide practitioners with a reference to which they can refer individuals concerned about the safety of herbicides and other commonly used chemicals.

### What are MSDS sheets? <sup>1,4</sup>

MSDS sheets are used for product stewardship and safety. These sheets contain data describing the properties of a particular substance and are intended to inform workers and other personnel about the risks associated with coming in contact with these substances. MSDS sheets provide pertinent information on how to properly handle, store and dispose of a substance, as well as any environmental or health risks associated with the material. MSDS sheets will state whether or not the substance is a carcinogen or teratogen and will provide information about acute toxicity often represented in the form of an LD<sub>50</sub> value.

### What are LD<sub>50</sub> values? <sup>2,4</sup>

In toxicology, an LD<sub>50</sub> value represents the dose of a chemical required to kill half of a tested population (usually mice or rats) after a specified duration. These values are frequently used as a general indicator of a substance's acute toxicity. Acute toxicity describes the adverse effects resulting from a single exposure to a chemical (i.e., accidental ingestion of a product). LD<sub>50</sub> values are expressed in units of milligrams (mg) of substance per kilogram (kg) of body weight. Toxicity increases as LD<sub>50</sub> values decrease. For example, a chemical with a LD<sub>50</sub> of 10 mg/kg is 10 times more toxic than one with a LD<sub>50</sub> of 100 mg/kg.

Considering that LD<sub>50</sub> studies are conducted on all chemicals sold in the United States, they can be used as a means to compare the toxicity of one chemical to another. Table 1 presents LD<sub>50</sub> values for many herbicides, as well as many chemicals commonly found in household products. MSDS sheets for most herbicides can easily be accessed for free from websites such as <http://www.cdms.net>.

MSDS sheets for household products can be accessed directly from company websites. Often, a single product may be sold by different companies. For example, several different brands of sodium hypochlorite

(i.e., bleach) can be found in most grocery stores. As a result, each product will have its own MSDS sheet with LD<sub>50</sub> values that may vary slightly. The values in Table 1 are simply examples presented as a guide for comparing the relative toxicity of one compound to another. Any discrepancy in this publication with a MSDS sheet is unintentional. If such a discrepancy exists within this publication, and in all cases, use the MSDS sheet as the authority to guide you in the legal use of the product.

### **What is a carcinogen? <sup>4</sup>**

A carcinogen is a substance that causes cancer. Carcinogens can increase cancer development by changing cellular metabolism or damaging cellular DNA. Once this happens, biological processes are disrupted and uncontrolled, leading to malignant cell division. Examples of commonly known carcinogens include asbestos and tobacco.

### **What is a teratogen? <sup>4</sup>**

A teratogen is a substance that causes abnormalities in physical development and/or birth defects. Birth defects occur in about 3 to 5 percent of newborns and are the leading cause of infant mortality. Many chemicals and environmental factors are suspected to cause teratogenic effects in humans and animals. Some examples of teratogens include caffeine, tobacco and radiation.

### **Discussion <sup>2,3,4</sup>**

Using LD<sub>50</sub> values as an indicator, many herbicides are less toxic than common chemicals such as caffeine (found in coffee, tea and many soft drinks) and nicotine (found in tobacco products). Pendimethalin, a commonly used herbicide in Tennessee, has an oral LD<sub>50</sub> value of greater than 5000 mg/kg, which is similar to ethanol, the active ingredient in Dawn Ultra™ dishwashing liquid.

This is not the case with all herbicides though. Paraquat, a restricted-use pesticide that can only be used by licensed pesticide applicators, has an LD<sub>50</sub> value of approximately 300 mg/kg; however, it is less

toxic than bleach. When used according to label instructions, Paraquat is a highly effective herbicide; however, end-users must take special precautions when applying the material (e.g., wear correct personal protective equipment, etc).

### **Conclusion**

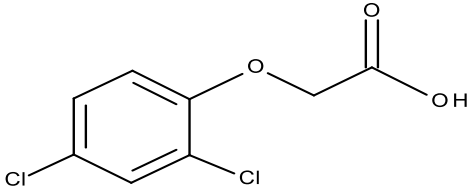
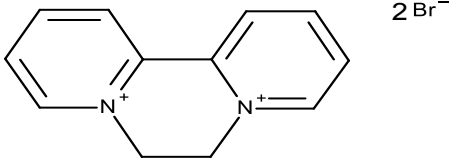
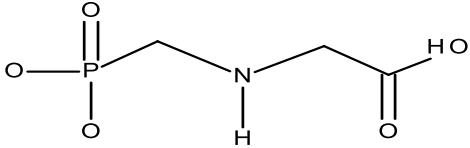
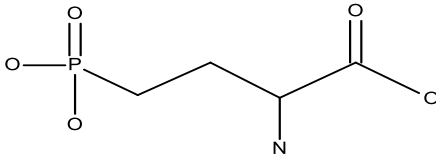
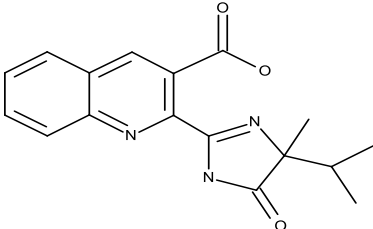
When used according to label instructions, herbicides are safe and effective. Many of the problems that have been associated with herbicides are the result of improper use. Similarly, many health problems have been linked to improper (e.g., excessive) use of substances like alcohol.

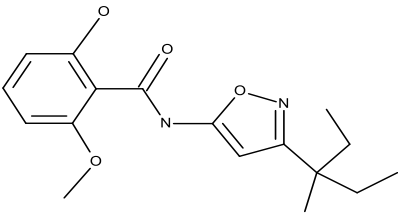
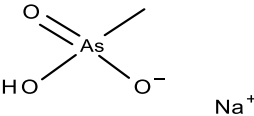
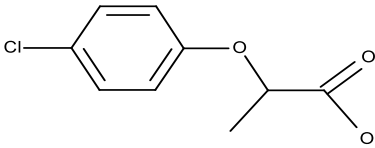
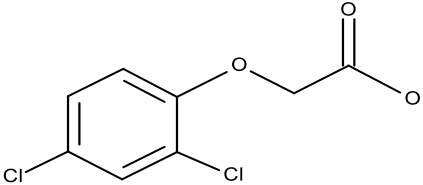
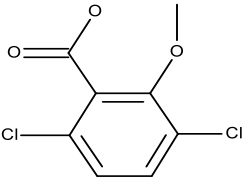
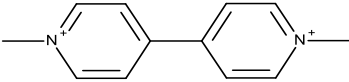
Before applying any herbicide, always refer to the product label for specific information on proper product use; tank-mix compatibility; and turfgrass, vegetable, fruit or ornamental tolerances. For more information on weed control, visit the University of Tennessee's turfgrass weed science website, <http://tennesseeturfgrassweeds.org> or the University of Tennessee horticultural weed control site at <http://hortweeds.tennessee.edu/>.

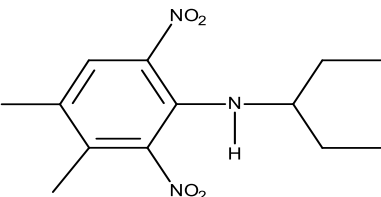
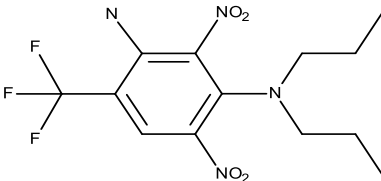
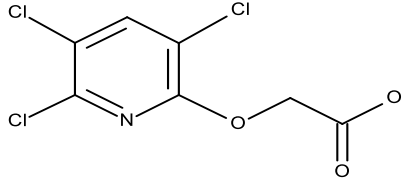
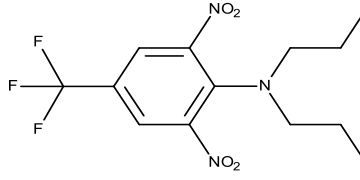
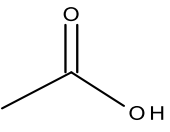
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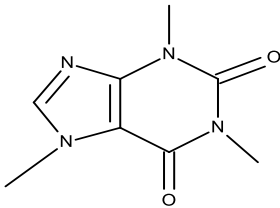
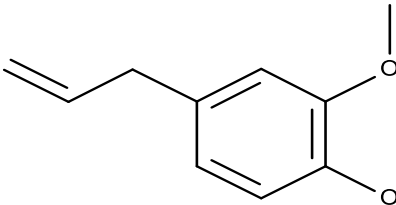
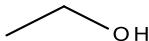
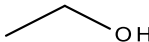
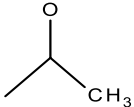
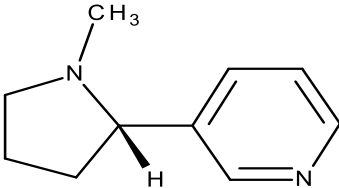
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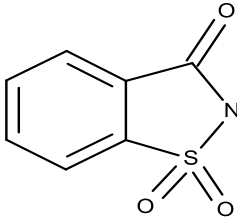
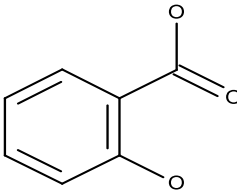
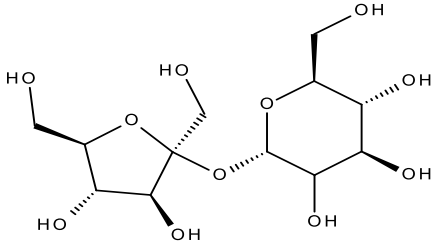
Table 1 LD<sub>50</sub> Values\*

Herbicides	Chemical Structure	LD <sub>50</sub> (mg/kg)			
		Oral	Dermal	Carcinogen	Teratogen
2,4-D		370	1500	No	Unlikely
Diquat (Reward)		886	>5000	No	Potential
Glyphosate (Roundup Pro)		5108	>5000	No	None
Glufosinate (Finale)		3570	>2000	No	None
Imazaquin (Image)		>5000	>2000	No	None

Isoxaben (Gallery)		>5000	>5000	Potential	Yes
MSMA		700	2500	Unknown	Unknown
MCPP+2,4-D+Dicamba (Trimec Classic)	  	>1550	>2240	Unknown	Unknown
Paraquat (Gramoxone Inteon)		310	>2000	No	None

Pendimethalin (Pendulum Aquacap)		>5000	>5000	No	None
Prodiamine (Barricade)		>5000	>2000	Potential	Yes
Triclopyr (Turflon Ester)		1338	>2000	Potential	None
Trifluralin (Trifluralin 10G/Preen)		>5050	>2020	No	Unknown
Common Chemicals	Chemical Structure	Oral	Dermal	Carcinogen	Teratogen
Acetic acid (Vinegar)		3310	>5000	No	Unknown
Sodium hypochlorite (Bleach)	$\text{Na}^+ \quad \text{Cl}-\text{O}^-$	192	NA	Unknown	Unknown

Caffeine		127	NA	Potential	Unknown
Clove oil		1370	1200	Unknown	Unknown
Ethanol + surfactant (Ultra Dawn)		6300	NA	No	Unknown
Ethyl alcohol (grain alcohol)		7060	NA	Unknown	Potential
Isopropyl alcohol (Windex)		>5000	>2000	Unknown	Unknown
Nicotine		3.4	50	Yes	Potential

Saccharin (Sweet-n-low)		14200	NA	Yes	Unknown
Salicylic acid (Aspirin)		200	NA	No	Potential
Crystalline silica (Silica sand)	$\text{O}=\text{Si}=\text{O}$	NA	NA	Yes	Unknown
Sodium chloride (Table Salt)	NaCl	3000	10 g/kg	Unknown	Unknown
Sucrose (Sugar)		29700	NA	No	Unknown

\*MSDS sheets for most herbicides can easily be accessed for free from websites such as <http://www.cdms.net>. MSDS sheets for household products can be accessed directly from company websites. Often, a single product can be sold by different companies. For example, several different brands of sodium hypochlorite (i.e., bleach) can be found in most grocery stores. As a result, each product will have its own MSDS sheet with LD50 values that may vary slightly. The values in this table are simply examples presented as a guide for comparing the relative toxicity of one compound to another. Any discrepancy in this publication with a MSDS sheet is unintentional. If such a discrepancy exists within this publication, and in all cases, use the MSDS sheet as the authority to guide you in the legal use of the product.